

Solving Problems on a Coordinate Plane

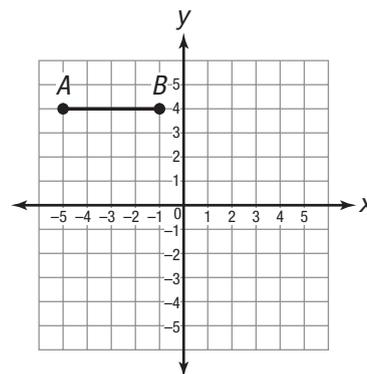
1 GETTING THE IDEA

You can use coordinates and absolute value to find the distance between two points on a coordinate grid.

To find the distance between the points $A(-5, 4)$ and $B(-1, 4)$, plot the ordered pairs and draw a line segment between the points.

The y -coordinates are the same, so the line is horizontal. The distance between the two points is the horizontal distance between the x -coordinates, -5 and -1 .

You can use any of these methods to find distance.



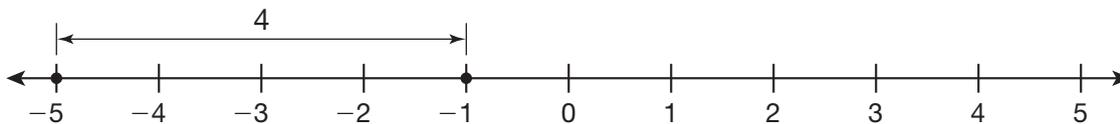
- Count the units between the points.

Start at point A .

Count the units as you move right to get to point B .

You move right 4 units from A to B .

- Use a number line.



The number line shows that the distance between -5 and -1 is 4 units.

- Use absolute value.

The number -5 is $|-5|$, or 5 units from 0.

The number -1 is $|-1|$, or 1 unit from 0.

Since both points are in the same quadrant, subtract to find the distance.

$$5 - 1 = 4 \text{ units}$$

All three methods show that the distance between points $A(-5, 4)$ and $B(-1, 4)$ is 4 units.

Example 1

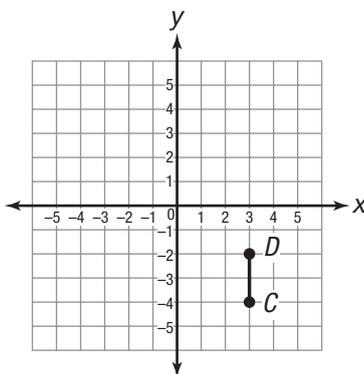
Find the distance between $C(3, -4)$ and $D(3, -2)$.

Strategy Use all three methods to find the distance.

Step 1

Plot each point on the coordinate plane. Draw a line segment between the points.

The x -coordinates are the same, so the line is vertical. The y -coordinates are -4 and -2 .



Step 2

Count to find distance.

The distance between the two points is the vertical distance between the y -coordinates, -4 and -2 .

Count the units between the points.

Start at point C .

Count the units as you move up to get to point D .

You move up 2 units from C to D .

Step 3

Use a number line to find distance.

Find the distance between -4 and -2 on a vertical number line.

The number line also shows that the distance between -4 and -2 is 2 units.

Step 4

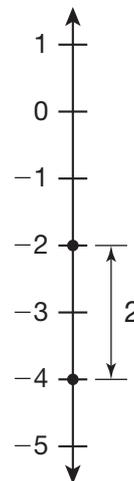
Use absolute value to find distance.

The number -4 is $|-4|$, or 4 units from 0.

The number -2 is $|-2|$, or 2 units from 0.

Since both points are in the same quadrant, subtract to find the distance.

$$4 - 2 = 2 \text{ units}$$



Solution The distance between points $C(3, -4)$ and $D(3, -2)$ is 2 units.

We found the distance between points in the same quadrant by subtracting the absolute values of the coordinates. When points lie in *different* quadrants, *add* their absolute values to find the distance between them.

Example 2

Find the distance between $R(-5, 3)$ and $S(-5, -2)$.

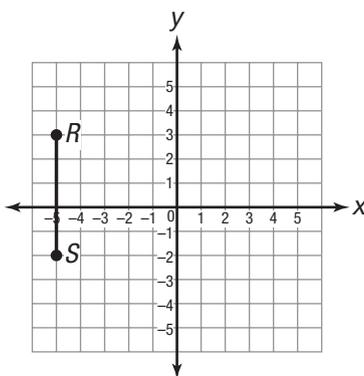
Strategy Use absolute value to find the vertical distance between points in different quadrants.

Step 1

Plot each point on the coordinate plane. Draw a line between the points.

The x -coordinates are the same, so the line is vertical.

The y -coordinates are -2 and 3 .



Step 2

Use absolute value to find distance.

The number -2 is $|-2|$, or 2 units from 0.

The number 3 is $|3|$, or 3 units from 0.

Since the points are in different quadrants, add to find the distance.

$$2 + 3 = 5 \text{ units}$$

Step 3

Count units between the points to check the answer.

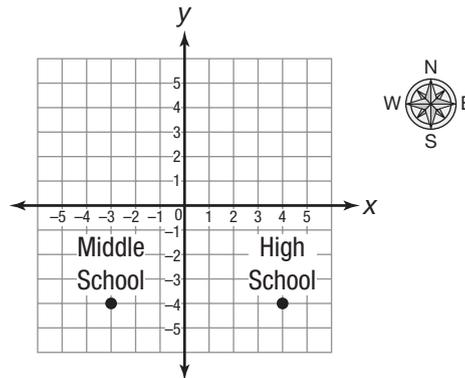
Start at point R . Count the units as you move down to get to point S .

You move down 5 units from R to S .

Solution The distance between points $R(-5, 3)$ and $S(-5, -2)$ is 5 units.

Example 3

The map of a town is placed on a coordinate grid. Each unit on the map represents 1 mile. Find the distance between the middle school and the high school. Then describe the location of the high school in relation to the middle school.



Strategy Use absolute value to find the distance on a map.

Step 1 Identify the coordinates of the locations on the map.

Middle school: $(-3, -4)$

High school: $(4, -4)$

The y-coordinates are the same, so the points lie on a horizontal line.

The x-coordinates are -3 and 4 .

Step 2 Use absolute value to find the distance between the points.

The number -3 is $|-3|$, or 3 units from 0.

The number 4 is $|4|$, or 4 units from 0.

Since the points are located in different quadrants, add to find the distance.

$$3 + 4 = 7 \text{ units}$$

Step 3 Describe the distance on the map.

The distance between the points is 7 units. Each unit on the map represents 1 mile.

So, the distance between the middle school and the high school is 7 miles.

The directions north, south, east, and west are labeled on the map. The high school is to the right of the middle school, so the high school is 7 miles east of the middle school.

Solution The distance between the middle school and the high school is 7 miles. The high school is 7 miles east of the middle school.

2 COACHED EXAMPLE

On a map, Rachel's house is located at $(2, 1)$. Each unit on the map represents one block. The dog park is 5 blocks south of Rachel's house. What are the coordinates of the location of the dog park?

Understand the situation.

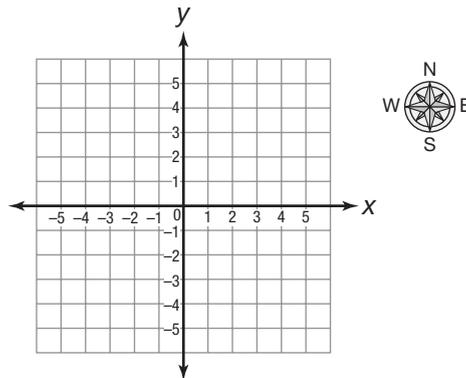
To move 5 blocks on the map, how many units do you move on the coordinate plane? _____

To move south on the map, what direction do you move on the coordinate plane? _____

Will the points lie on a vertical or a horizontal line? _____

Will the points have the same x -coordinates or y -coordinates? _____

Plot the locations of Rachel's house and the dog park on the map.



Use absolute value to check the distance between the points you plotted.

Since the points are in different quadrants, _____ to find the distance.

Write an equation showing the distance between the points.

Equation: _____

The distance between the points is _____.

The coordinates of the dog park are _____.

3 LESSON PRACTICE

- 1 For each pair of points in the table, indicate with an “X” whether the points lie on a horizontal line or on a vertical line, and whether the points lie in the same quadrant or two different quadrants.

Points	Horizontal Line, Same Quadrant	Horizontal Line, Two Quadrants	Vertical Line, Same Quadrant	Vertical Line, Two Quadrants
$(5, -2), (5, 2)$				
$(6, 4), (2, 4)$				
$(-3, 1), (3, 1)$				
$(-1, -3), (-1, -2)$				

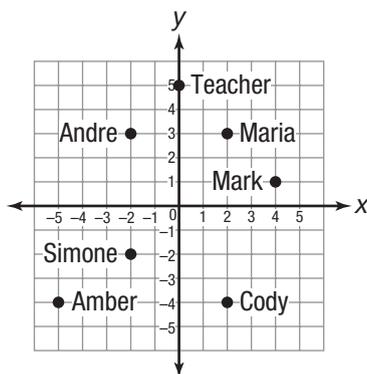
- 2 On a map, Anya’s house is located at $(3, 1)$. Anya lives 3 blocks north of the fire station and 2 blocks east of the post office. Select the ordered pair that makes each statement true.

The fire station is located at $(3, 4)$.
 $(3, -2)$.
 $(6, 1)$.

The post office is located at $(1, 1)$.
 $(3, 3)$.
 $(5, 1)$.

- 3 Select the pairs of points that have a distance of 6 units between them. Circle all that apply.
- A. $(3, 5)$ and $(3, 1)$
 - B. $(2, 4)$ and $(-4, 4)$
 - C. $(-1, 3)$ and $(-1, -3)$
 - D. $(-4, -5)$ and $(-2, -5)$
 - E. $(0, -6)$ and $(0, 0)$
 - F. $(-7, -1)$ and $(1, -1)$

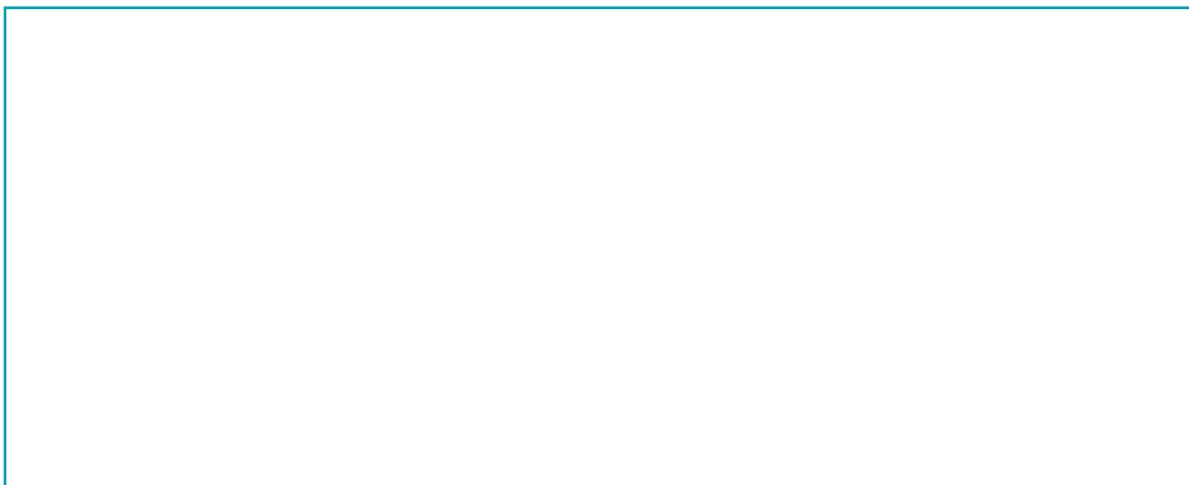
- 4 The map shows the locations of several desks in a classroom. Select True or False for each statement.



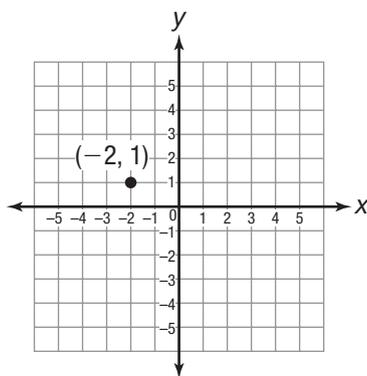
- A. Andre sits closer to Maria than to Simone. True False
- B. The distance between Cody and Amber is 6 units. True False
- C. The distance between Maria and Cody is equal to $|-4| + |3|$. True False
- D. Maria's desk is a reflection of Andre's desk over the y-axis. True False

- 5 Cole says the distance between points $(-5, 0)$ and $(0, 5)$ is 5 units. Is he correct? Explain why or why not.

- 6 The vertices of a rectangle are $W(1, 2)$, $X(4, 2)$, $Y(4, -3)$, and $Z(1, -3)$. Find the perimeter of the rectangle. Use words, numbers, or models to justify your answer.



- 7 Plot four points that are 3 units from the point $(-2, 1)$. Label the points on the graph.



- 8 The point $(1, -4)$ is reflected across the x -axis.

Part A

Find the distance between the point and its reflection. Explain your reasoning.

Part B

Will the distance between a point with whole-number coordinates and its reflection over the x -axis always be an even number? Explain.

- 9 Name two points in different quadrants that have the same y -coordinates and are 7 units apart. Justify your answer.

- 10 The tennis courts are 3 blocks west and 2 blocks south of Miguel's house. The bike path is 5 blocks east and 2 blocks south of Miguel's house. How far are the tennis courts from the bike path? Explain your reasoning.

_____ blocks

- 11 Use the descriptions to plot each location on the map of a school. Then complete the table to show the ordered pair for each location.

- The office is located at the origin.
- The computer lab is located at $(-4, -3)$.
- The library has the same x -coordinate as the computer lab, and a y -coordinate of 1.
- The art room is 1 unit right and 4 units up from the library.
- The reflection of the art room across the y -axis is the location of the cafeteria.
- The gymnasium is 9 units down from the cafeteria.

Location	Ordered Pair
Office	(\square, \square)
Computer lab	(\square, \square)
Library	(\square, \square)
Art room	(\square, \square)
Cafeteria	(\square, \square)
Gymnasium	(\square, \square)

